CHAPTER 4

NOTES

RESPONSE TO NATURAL IMPACTS AND HUMAN ACTIONS

4.1 Evolutionary History of Natural Impacts

Euro-American settlement of western North America in the 19th and 20th centuries changed the type, timing, and intensity of natural disturbance. The following is a discussion of the nature of two processes—grazing and fire—in presettlement ecosystems.

4.1.1 Grazing Characteristics

Soil and plant characteristics of low- and mid-elevation arid and semi-arid ecosystems in North America west of the Rocky Mountains indicate that these ecosytems evolved with low levels of soil surface disturbance. This is suggested by these ecosystems' dependence on nitrogen provided by the biological soil crusts (Evans and Ehleringer 1993; Evans and Belnap 1999) and by dominant bunchgrasses' lack of adaptation (such as tillering, secondary compounds, or high tissue silica content) to grazing (Mack and Thompson 1982; Martin 1975; Stebbins 1981). Large mammal numbers would have been low due to limited surface water and sparse vegetation. Limited water availability would have restricted use of lower elevations to winter seasons, as is seen today (West 1988; Parmenter and Van Devender 1995). Dung beetles, present globally in other systems with large mammal herds, are also lacking in western North America (Fig. 4.1; Mack and Thompson 1982). Shallow soils can also limit distributions of burrowing vertebrates and invertebrates, further reducing soil surface disturbance. Current natural

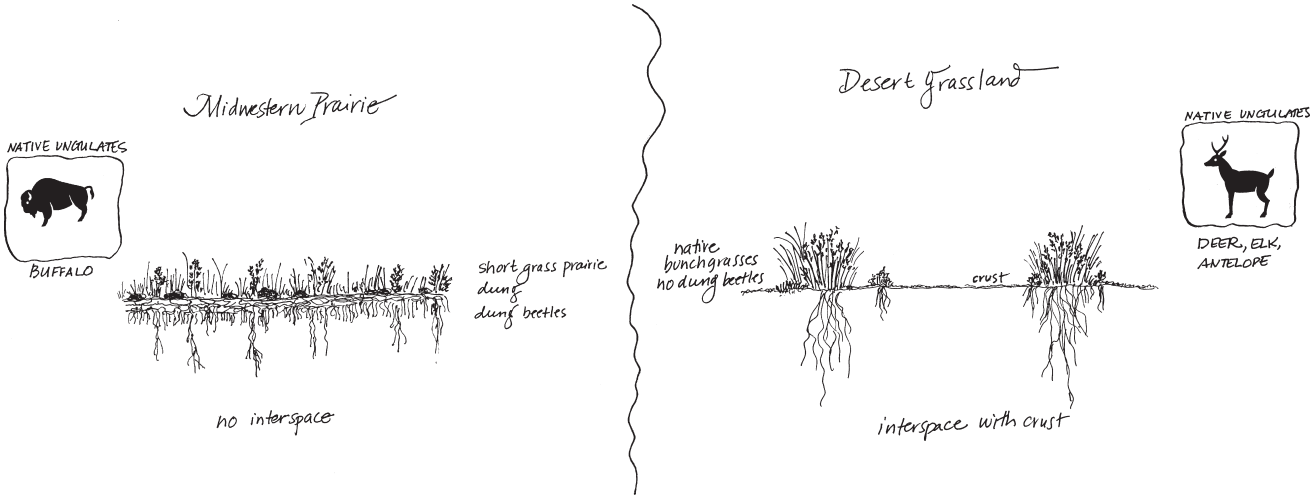

Figure 4.1 *Comparison of community structure in ecosystems that evolved with (midwestern prairie) and without (desert grassland) large herds of grazing mammals.*

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disturbance by large mammals and burrowing fauna in western North American deserts is greatest in the Sonoran and Chihuahuan Deserts, moderate in the Mojave Desert and Great Basin, and low in the Colorado Plateau. Because of their evolutionary history, these regions appear to be more negatively affected by soil surface disturbances than regions like the Great Plains that evolved with higher levels of surface disturbance (see section 4.2).

4.1.2 Fire

In arid and semi-arid native communities, plants have patchy distributions that result in discontinuous fuel and mosaics of various fire intensities (Whisenant 1990). Biological soil crusts provide little fuel to carry a fire through interspaces, thereby acting as "refugia" to slow the spread of fire and decrease its intensity (Rosentreter 1986). Unburned islands of vascular vegetation and biological soil crust provide propagules for reestablishment in burned areas (Fig. 4.2). Johansen et al. (1993) observed that the crust's structural matrix was left intact following low-intensity fire, indicating that a lightly burned crust still functions to maintain stability against erosive forces for both vascular plants and biological soil crusts during the recovery period.

Fire is a natural determinant of the sagebrush-steppe potential vegetation types. Historical fire patterns helped create mosaics of successional stages in both vascular plant and biological soil crust communities. More productive sites generally have fire-return intervals of less than 30 years (Burkhardt and Tisdale 1976; Arno and Gruell 1983; Fisher et al. 1987). Although this time period might constrain biological soil crust recovery, higher precipitation enhances regrowth (see section 4.3.3; McCune 1993). Fifty to 100 years has often been cited as the average return interval in shrub-steppe regions (Wright et al. 1979; Peters and Bunting 1994) and is adequate to restore biological soil crust components. However, there is no direct evidence for fire being a cyclic disturbance in lower elevation shrub-steppe. Here, shrub die-off from insect, disease, and winter kill is common and is probably responsible for most shrub turnover (McArthur et al. 1990). Historic fires were probably small, low intensity, patchy, and uncommon because of sparse and discontinous vegetation. Fire was not historically a common disturbance in most salt-desert shrub types (West 1994), except for the more productive types supporting Great Basin wildrye (*Elymus cinereus*). Likewise, sparsity of vegetation in the southwestern deserts resulted in long fire-return intervals and low-intensity fires (Allen 1998).

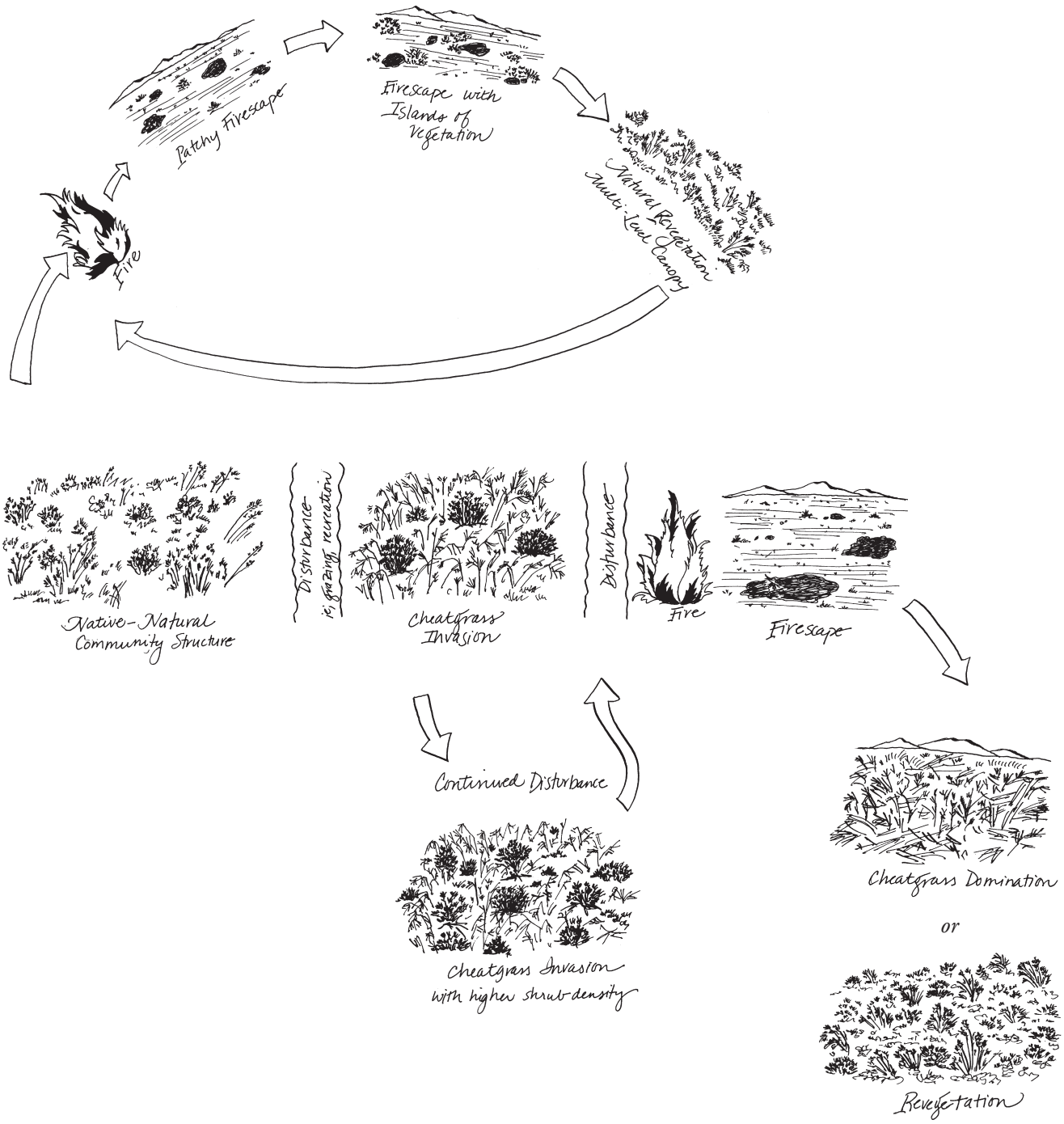

Figure 4.2 *Natural and altered fire cycles in sagebrush communities of the Great Basin. Fire at natural frequencies (50-100 year intervals or longer) occurred in a mosaic of intensities over the landscape due to discontinuity of fuel. This allowed natural regeneration of both the vascular plant and biological soil crust communities. Invasion of exotic species such as cheatgrass into these communities resulted in continuous fine fuels and larger, more intensive fires. Cheatgrass will often dominate the community following fire. Revegetation with perennial species can help reestablish a more natural community structure.*